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For: SYSTEM DIAGNOSIS APPARATUS, SYSTEM  
DIAGNOSIS METHOD AND COMPUTER-  
READABLE RECORDING MEDIUM RECORDING  
SYSTEM DIAGNOSIS PROGRAM

Enclosed are:

- (X) 57 pages of specification, including 8 claims and an abstract.  
(X) an executed oath or declaration, with power of attorney.  
( ) an unexecuted oath or declaration, with power of attorney.  
( ) sheet(s) of informal drawing(s).  
(X) 18 sheet(s) of formal drawings(s).  
(X) Assignment(s) of the invention to FUJITSU LIMITED.  
(X) Assignment Form Cover Sheet.  
(X) A check in the amount of \$ 40.00 to cover the fee for recording the assignment(s) is enclosed.  
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( ) Associate power of attorney.  
(X) Priority Document.


#### Fee Calculation For Claims As Filed

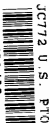
a) Basic Fee					\$ 690.00
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SYSTEM DIAGNOSIS APPARATUS, SYSTEM DIAGNOSIS METHOD  
AND COMPUTER-READABLE RECORDING MEDIUM RECORDING  
SYSTEM DIAGNOSIS PROGRAM

5 FIELD OF THE INVENTION

The present invention relates to system diagnosis apparatus, system diagnosis method and computer-readable recording medium recording system diagnosis program.

10 BACKGROUND OF THE INVENTION

In a large enterprise organizing an information system department, the computer system is operated and managed by expert system engineers well versed in computer systems. In order to maintain the performance such as response and through-put at high level, performance diagnosis of resources composing the computer system such as central processing unit (CPU) and magnetic disk devices (called disks hereinafter) is executed as routine work during the management. If performance drop is found in any resource, the system engineers investigate the cause and properly upgrade that resource.

There are enterprises which can not employ exclusive system engineers because of limited budget. Such enterprises must consign operation and management of the computer system to another company that is specialized in the maintenance work (here after maintenance firm). In this case, therefore, the

performance of resources is diagnosed regularly (or irregularly) by customer engineers dispatched from the maintenance firm.

In such operation management system, however, it is actually difficult to diagnose the performance in a thoroughly understanding state of the computer system of the specific enterprise and a customer engineer engaged in performance diagnosis may overlook the cause of performance drop of resources. Under this condition, even if the resource is upgraded, the performance does not improved and the quality of customer service may be lowered. Hitherto, therefore, there has been a keen desire for development of means and method of enhancing the quality of customer service without depending on the skill of the customer engineers engaged in the operation management tasks.

Conventionally, in operation and management of a system composed of computers, the manager judges the performance on the basis of the utility rate about the system resources (CPU, disks) that compose the system. When the utility rate exceeds a threshold, the manager judges that the performance of the system resource has lowered. In such as case, the deteriorated system resource is replaced by a new system resource of higher performance, or another system resource is added.

For example, if the case the system resource is the CPU, then the present CPU is replaced by a CPU having a higher

frequency than the clock frequency of the present CPU. If the system resource is a disk, another disk is added.

Conventionally, as mentioned above, when the performance of the system resources (CPU, disks) is lowered, an attempt is made to avoid the drop of the performance by replacing the existing system resource with a system resource of a higher performance, or adding a new system resources.

Generally, only when the cause of performance drop of the system resource is correctly investigated the performance of the system resource can be maintained above a specified level. The conditions that lower the performance of the CPU, for example, include high utility rate and long queue waiting for execution of process. If these are the causes, then it is effective to install an additional CPU. On the other hand, if high utility rate the only cause, then it is effective to replace the existing CPU with a better CPU.

The conditions that lower the disk performance include high utility rate, long queue waiting for read/write demand and long response time. If these are the causes, it is effective to install additional disks. On the other hand, if high utility rate and response time are the only causes, then it is effective to replace the existing disk with a better disk.

However, in order to judge the cause of performance drop of system resources, the engineers are required to have a thorough knowledge of the system under investigation. For the

enterprise having the performance of system resources diagnosed regularly (or irregularly) by the customer engineers dispatched from the maintenance firm, in reality, it is very difficult to diagnose the performance in a state of full understanding of the computer system of the specific enterprise.

Therefore, the customer engineer responsible for performance diagnosis may overlook the cause of performance drop of system resources. In such a case, even if the system resource is upgraded, the performance is not improved so much. Regarding the CPU, for example, supposing the queue waiting for execution of process is one of the causes that generate the drop in the performance, even if the CPU is replaced with a better CPU, the performance of the CPU is not improved so much. Similarly, in the case of the disk, even if disks are added although the utility rate and response time are the causes that generate the drop in the performance, the disk performance is not improved so much.

Thus, in the event of wrong judgement of cause of performance drop of system resources, not only the quality of the customer service is lowered, but also it is accompanied by wasteful extra steps such as redoing of diagnosis and follow-up of the user by the sales staff.

Moreover, when upgrading the system resources, the system resources are ordered manually. This may cause ordering errors due to human interaction, or may take time in the ordering

process.

The present invention is achieved in the light of the  
aforesaid problems. It is an object of this invention to  
provide a system diagnosis apparatus, a system diagnosis method  
and a computer-readable recording medium recording system  
diagnosis program, capable of determining measures against drop  
or shortage of performance of system resources and ordering  
necessary system resources accurately and promptly.

#### SUMMARY OF THE INVENTION

The present invention is achieved in the light of the  
aforesaid problems. It is an object of this invention to  
provide a system diagnosis apparatus, a system diagnosis method  
and a computer-readable recording medium recording system  
diagnosis program, capable of determining measures against drop  
or shortage of performance of system resources and ordering  
necessary system resources accurately and promptly.

According to one aspect of this invention, in the system  
diagnosis apparatus, when the utility rate of the system  
resource is greater than its threshold and the queue is shorter  
than its threshold, a diagnosis unit diagnoses that the  
performance of the user system resource has lowered. In this  
case, the existing system resource is replaced by a system  
resource of higher performance than this system resource. On  
the other hand, when the utility rate is greater than its

threshold and the queue is longer than its threshold, the diagnosis unit diagnoses that the number of system resources is insufficient. In this case, system resources are added to cover up for the shortage. Thus, the system resources are  
5 diagnosed on the basis of the results of comparison between the utility rate and its threshold and between the queue and its threshold.

Further, a system resource determining unit which determines the system resource to be upgraded when the diagnosis  
10 unit diagnoses that the performance of the system resource has lowered is provided. Further, an ordering unit makes an order of the determined system resource. On the other hand, when it is diagnosed by the system diagnosis unit that the number of system resources is insufficient, the number of system  
15 resources capable of exhibiting the specified performance is determined by the system resource determining unit. In this case, the system sources to cover up for the shortage are ordered by the ordering unit. Thus, the system resources for upgrading are ordered by the ordering unit on the basis of the result of  
20 determination by the system resource determining unit.

Further, an ordering unit directly transmits the ordering information about the system resources for updating to the device of the supplier's side through the network.

Further, the result of diagnosis by the diagnosis unit  
25 is noticed to the user through the network.

Further, out of the system resources determined by the system resource determining unit only the system resources required to be updated are ordered as the system resources for upgrading on the basis of the flag.

5 Further, the system resources are diagnosed on the basis of the results of comparison between the utility rate and its threshold, comparison between the queue and its and further comparison between the response time and its threshold.

According to another aspect of this invention, in the  
10 system diagnosis method, when the utility rate of the system resource is greater than its threshold and the queue is shorter than its threshold, a diagnosis unit diagnoses that the performance of the user system resource has lowered. In this case, the existing system resource is replaced by a system  
15 resource of higher performance than this system resource. On the other hand, when the utility rate is greater than its threshold and the queue is longer than its threshold, the diagnosis unit diagnoses that the number of system resources is insufficient. In this case, system resources are added to  
20 cover up for the shortage. Thus, the system resources are diagnosed on the basis of the results of comparison between the utility rate and its threshold and between the queue and its threshold.

According to still another aspect of this invention, the  
25 program for executing the system diagnosis method is stored on



a recording medium. This program can be easily read on a computer and the system diagnosis method can be easily executed using the computer.

Other objects and features of this invention will become  
5 apparent from the following description with reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing a schematic constitution in  
10 an embodiment of the present invention;

Fig. 2A to Fig. 2C are diagrams showing the examples of the CPU utility rate in a user system 10 shown in Fig. 1 and Fig. 4;

Fig. 3A and Fig. 3B are diagrams showing the examples of  
15 the disk utility rate and disk response time in the user system 10 shown in Fig. 1 and Fig. 4;

Fig. 4 is a block diagram showing a constitution of this embodiment;

Fig. 5 is a diagram showing system performance  
20 information  $J_1$  shown in Fig. 4;

Fig. 6 is a diagram showing a system configuration table  $T_1$  shown in Fig. 4;

Fig. 7A to Fig. 7D are the tables shown in Fig. 4;

Fig. 8 is a flowchart for explaining the operation of this  
25 embodiment;

Fig. 9 is a flowchart for explaining the acquisition process of system resource information shown in Fig. 8;

Fig. 10 is a flowchart for explaining the analysis process of CPU performance information shown in Fig. 8;

5 Fig. 11 is a flowchart for explaining the analysis process of disk performance information shown in Fig. 8;

Fig. 12 is a flowchart for explaining the ordering process shown in Fig. 8;

10 Fig. 13 is a diagram showing an example of system diagnosis report in this embodiment;

Fig. 14 is a diagram showing an example of system diagnosis report in this embodiment;

Fig. 15 is a diagram showing an example of system diagnosis report in this embodiment;

15 Fig. 16 is a diagram showing an example of order confirm screen 100 in this embodiment; and

Fig. 17 is a block diagram showing a modified example of this embodiment.

## 20 DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, the system diagnosis apparatus, system diagnosis method and computer-readable recording medium recording system diagnosis program of the present invention are described in detail below.

25 Fig. 1 is a diagram showing a schematic constitution of

the embodiment of this invention. As show in this figure, a user system 10 is installed at the user side and is composed of mail server, printer server, job server and many (or only one) computers as personal terminals. Hereinafter, the mail server, printer server and others are collectively called the user system 10 and the user system 10 is supposed to be composed of four computers in total, that is, mail server, printer server, job server and personal terminal. This user system 10 is composed of system resources such as CPU, disks and memories. Actually, the system resources are present in each one of the mail server, printer server, job server and personal terminal.

The user system 10 includes a function of storing the performance information of system resources in operation (hereinafter called system performance information) in a not shown memory unit and issuing the system performance information to outside when a necessary command is input. The system performance information includes the CPU utility rate, length of execution queue for CPU, disk utility rate, length of demand queue for disk, disk response time and others.

The CPU utility rate is the ratio of run time of the CPU executing the program to the measuring time required for measurement of the CPU utility rate (run time/measuring time). For example, of the measuring time of 10 minutes, if the run time is 3 minutes and 30 seconds, the CPU utility rate is 35%.

Fig. 2A to Fig. 2C are diagrams showing examples of time sequence

changes of the CPU utility rate in the user system 10. In Fig. 2A to Fig. 2C, the axis of abscissas is the time axis having a range from 10:07 to 18:07 and the axis of ordinates represents the CPU utility rate.

Fig. 2A shows the changes of the CPU utility rate of two CPU, CPU 0 and CPU 1. Fig. 2B shows the CPU utility rate of all the CPUs (in this case, CPU 0 and CPU 1). Fig. 2C shows the CPU utility rate occupied by process 1, process 2 and the system (operating system).

The execution queue is the number of other programs that form a queue while the CPU is executing one program. In other words, the execution queue is the number of other processes waiting for execution while one process is occupying the CPU.

The disk utility rate is the ratio of the operating time required for read/write operation to the measuring time required for measuring the disk utility rate (operating time/measuring time). For example, of the measuring time of 10 minutes, when the operating time is 2 minutes, the disk utility rate is 20%. Fig. 3A shows an example of time sequence changes of disk utility rate in the user system 10. In Fig. 3A, the axis of abscissas is the time axis having a range from 10:07 to 18:07 and the axis of ordinates represents the disk utility rate.

The demand queue is the number of other read/write demands that form a queue while the disk is executing read/write

operation. The disk response time is the time from issue of read/write demand to the disk until end of read/write operation. Fig. 3B shows an example of time sequence changes of disk response time in the user system 10. In Fig. 3B, the axis of abscissas is the time axis having a range from 10:07 to 18:07 and the axis of ordinates represents the disk response time.

Returning to Fig. 1, the user system 10 is connected to a network N such as the Internet or other exclusive line and has a communication function for communicating with a system diagnosis apparatus 20 installed at an external maintenance firm. The user system 10 also has a function of issuing the system performance information stored in the memory unit to the outside, when a necessary command is entered through the local operation or remote operation. The system performance information may be output to a recording medium such as the floppy disk or the optical disk or it may be output to the system diagnosis apparatus 20 through the network N.

The system diagnosis apparatus 20 includes an acquisition function of acquiring system performance information from the user system 10 through a recording medium or the network N. Further, the system diagnosis apparatus 20 includes a diagnosis function of diagnosing the performance of system resources by analyzing the system performance information. Further, the system diagnosis apparatus 20 also includes a reporting function of reporting the diagnosis result to the user and an

ordering function of ordering parts (system resources) if upgrading of system resources is necessary on the basis of the diagnosis result.

The system diagnosis apparatus 20 is connected to the user  
5 system 10 and a factory/parts center system 40 through the network N. Therefore, the system diagnosis apparatus 20 accesses the user system 10 through the network N when acquiring the system performance information and when reporting the diagnosis result. Further, the system diagnosis apparatus 20  
10 accesses the factory/parts center system 40 through the network N when ordering the parts.

The factory/parts center system 40 is a computer, which is installed at the manufacturing factory of the user system 10 or the parts center having a stock of upgrading parts (system  
15 resources: CPU, disk, etc.) about the user system 10. The factory/parts center system 40 includes a communication function for communicating with the system diagnosis apparatus 20 through the network N and an ordering control function for controlling order of parts. The worker at the manufacturing  
20 factory/parts center delivers the requested parts to the user according to the ordering management of the factory/parts center system 40.

Referring next to Fig. 4, the constitution of this embodiment will be described in detail. In Fig. 4, the sections  
25 that perform the similar functions as those in Fig. 1 have been

provided with same reference numerals. In the user system 10 shown in Fig. 4, CPU 11 and disk 12 are system resources that make the user system 10 and are also the objects of diagnosis of the performance. Actually, many (or only one) CPUs and/or  
5 disks are provided for each computer the user system 10.

In the system diagnosis apparatus 20, a system configuration table  $T_1$  and an application definition table  $T_2$  are stored in the memory unit 21. The system configuration table  $T_1$  is, as shown in Fig. 6, a table composed of the  
10 specification of system resources in the user system 10, application of computer system for composing the user system 10, information about upgrading of system resources and information about ordering of system resources.

That is, the system configuration table  $T_1$  is composed  
15 of machine ID, mounted CPU information, mounted disk information, application information, CPU upgrade recommended information, disk upgrade recommended information, CPU order information and disk order information.

Among these pieces of information, the machine ID,  
20 mounted CPU information, mounted disk information and application information are individually set in the table initial setting unit 23 mentioned below before diagnosing about the user system 10. The CPU upgrade recommended information and disk upgrade recommended information are set after  
25 diagnosis about the user system 10. The CPU order information

and disk order information are set when ordering the parts (system resources) to the factory/parts center system 40.

The machine ID is an identifier individually given to a total of four computers that make the user system 10 and in the  
5 illustrated example, the machine ID is A, B, C and D.

The mounted CPU information is the information about the specification of the CPU (system resources) mounted on each one of the four computers that make the user system 10. More specifically, the mounted CPU information is composed of the  
10 number of mountable CPUs showing the maximum number of CPUs that can be mounted on that particular computer, the CPU model name showing the model name of the CPU actually mounted on the computer, the CPU performance showing the clock frequency of the CPU actually mounted on the computer and the number of CPU  
15 mounted showing the number of CPUs actually mounted on the computer.

For example, in the computer having the machine ID of A, the number of mountable CPUs is 2, the CPU model name is SPII, the CPU performance is 233 and the number of CPU mountable is  
20 1. Therefore, in this computer, as the number of mountable CPUs is 2 and the CPU quantity is 1, there is a room for one more CPU.

The mounted disk information is the information about the specification of the disks (system resources) mounted on each  
25 one of the four computers that make the user system 10. More



specifically, the mounted disk information is composed of the disk model name showing the model name of the disk actually mounted on the computer, the disk performance showing the rotating speed of the magnetic disk incorporated in the disk and the number of disks mounted showing the number of disks that are actually mounted on that particular computer.

For example, in the computer having the machine ID of A, the disk model name is SG2, the disk performance is 5500 and the number of disks mounted is 1. Similarly, in the computer having the machine ID of B, the disk model name is AL2, the disk performance is 7200 and the number of mounted disks is 3.

The application information is the information showing the applications of the four computers for composing the user system 10. More specifically, the computer having the machine ID of A is used as a mail server and the computer having the machine ID of B is used as a printer server. Similarly, the computer having the machine ID of C is used as a job server and the computer having the machine ID of D is used as a personal terminal.

The CPU upgrade recommended information is the information about the CPU recommended to be upgraded by the maintenance firm of the user system 10. The upgrading techniques of the CPU include a technique of adding (extending) a new CPU and a technique of replacing the existing CPU with a CPU having a higher performance.

In the case of the former technique, a CPU having a same clock frequency as the clock frequency of the existing CPU is newly added. This technique is effective for enhancing the through-put. On the other hand, in the case of the latter  
5 technique, the existing CPU is replaced by a CPU having a higher clock frequency than the clock frequency of the existing CPU. This technique is effective for enhancing the response time (processing time).

More specifically, the CPU upgrade recommended  
10 information is composed of the CPU model name and number of CPUs. The CPU model name is the model name of the CPU recommended to be upgraded by the maintenance firm and the number of CPUs is the number of CPUs that are required to be upgraded.

What is of note here is that when the CPU model name of  
15 the CPU upgrade recommended information and the CPU model name of the mounted CPU information are identical, the former CPU model name shows the model name of the CPU recommended to be added by the maintenance firm. In this case, moreover, the number of CPUs in the CPU upgrade recommended information shows  
20 the sum of the number of CPUs already mounted and the number of CPUs recommended to be added by the maintenance firm.

On the other hand, when the CPU model name of the CPU  
upgrade recommended information and the CPU model name of the mounted CPU information are different, the former CPU model name  
25 shows the model name of the CPU in the case of recommendation

for upgrading by replacing the existing CPU with a CPU having a higher clock frequency. In this case, the number of CPUs in the CPU upgrade recommended information represents the number of CPUs recommended to be replaced by the maintenance firm.

5           The disk upgrade recommended information is the information about the disk recommended to be upgraded by the maintenance firm of the user system 10. Herein, the upgrading techniques of the disk include a technique of adding (extending) a new disk and a technique of replacing the existing disk with  
10 a disk of a higher performance.

In the case of the former technique, a disk having a same rotating speed as the rotating speed of the existing disk is newly added. This technique is effective for enhancing the through-put. On the other hand, in the case of the latter  
15 technique, the existing disk is replaced by a disk having a higher rotating speed than the rotating speed of the existing disk. This technique is effective for enhancing the response time (processing time).

More specifically, the disk upgrade recommended  
20 information is composed of the disk model name and number of disks. The disk model name is the model name of the disk recommended to be upgraded by the maintenance firm and the number of disks is the number of disks required to be upgraded. What is of note here is that when the disk model name of the  
25 disk upgrade recommended information and the disk model name

of the mounted disk information are identical, the former disk model name shows the model name of the disk recommended to be added by the maintenance firm. In this case, moreover, the number of disks in the disk upgrade recommended information represents the sum of the number of disks already mounted and the number of disks recommended to be added by the maintenance firm.

On the other hand, when the disk model name of the disk upgrade recommended information and the disk model name of the mounted disk information are different, the former disk model name shows the model name of the disk in the case of recommendation for upgrading by replacing the existing disk with a disk of higher rotating speed. In this case, the number of disks in the disk upgrade recommended information shows the number of disks recommended to be replaced.

The CPU order information is the information about ordering of CPU for upgrading and is composed of CPU model name and number of CPUs ordered. The CPU model name shows the model name of the CPU to be ordered, which corresponds to the CPU model name in the CPU upgrade recommended information. The number of CPUs ordered is the number of CPUs to be ordered to the factory. In the computer having the machine ID of C, the CPU model name is ZZ3 and the number of CPUs ordered is 2.

Herein, if the CPU model name of the CPU order information and the CPU model name of the mounted CPU information are

different, the number of CPUs ordered and number of CPUs mounted are identical. If they are identical, the number of CPUs ordered is the balance of subtraction of the number of CPUs ordered of the mounted CPU information from the number of CPUs  
5 of the CPU upgrade recommended information.

The disk order information is the information about ordering of disk for upgrading and is composed of disk model name and number of disks ordered. The disk model name shows the model name of the disk to be ordered, which corresponds to  
10 the disk model name in the disk upgrade recommended information. The number of disks ordered is the number of disks to be ordered to the factory.

Herein, if the disk model name of the disk order information and the disk model name of the mounted disk  
15 information are different, the number of disks ordered and number of disks mounted are identical. If they are identical, the number of disks ordered is the balance of subtraction of the number of disks mounted of the mounted disk information from the number of disks of the disk upgrade recommended information.

Returning to Fig. 4, the application definition table  $T_2$   
20 is a table that defines the application of the plurality of computers as the object of diagnosis by the system diagnosis apparatus 20 and necessity of upgrading corresponding thereto. More specifically, as shown in Fig. 7A, the application  
25 definition table  $T_2$  is composed of application information and

upgrading flag. The application information includes the mail server, printer server, FTP (file transfer process) server, job server and personal terminal.

The upgrading flag is a flag showing whether it is necessary to upgrade the system resources (CPU, disk, etc.) that make the computer. More specifically, the upgrading flag 1 shows it is necessary to upgrade according to the result of diagnosis when it is diagnosed necessary to upgrade the system resources for composing the computer. On the other hand, the upgrading flag 0 shows it is not necessary to upgrade, regardless of the result of diagnosis even if it is diagnosed necessary to update.

In other words, the upgrading flag expresses the review result of cost effect of upgrading. That is, the upgrading flag is 1 (upgrading necessary) for the mail server, printer server and job server (see Fig. 7A) which are regarded to be high in importance by the user.

On the contrary, in the FTP server and personal terminal which are regarded to be low in importance by the user, the upgrading flag is 0 (upgrading not necessary). Since the standard about necessity of upgrading varies depending upon the user, the application definition table  $T_2$  is set separately for each user.

Returning to Fig. 4, in the memory unit 22, the system performance information  $J_1$ , threshold table  $T_1$ , CPU list table

$T_1$  and disk list table  $T_2$  are stored. The system performance information  $J_1$  is the performance information (CPU utility rate, disk utility rate, etc.) of system resources (CPU, disk) in operation of the user system 10 and is acquired from the user system 10 through the network N or the recording medium 31. This recording medium 31 is for recording the system performance information stored in the memory unit of the user system 10 and is a floppy disk, optical disk or the like.

More specifically, the system performance information  $J_1$ , as shown in Fig. 5, is composed of the measured data and average of the aforesaid CPU utility rate, execution queue for the CPU, disk utility rate, demand queue for the disk and disk response time. The CPU utility rate and execution queue for the CPU are the CPU performance information for analyzing the performance of the CPU. The disk utility rate, demand queue for the disk and disk response time are the disk performance information for analyzing the performance of the disk.

In the example shown in Fig. 5, the system performance information  $J_1$  is composed of the data measured in the time zone from 10:00:00 to 12:10:00. Although not shown in Fig. 5, the system performance information  $J_1$  also includes measured data in other time zone and their average.

Returning to Fig. 4, the threshold table  $T_2$  is composed of the plurality of threshold values used in diagnosis of system resources (CPU, disk) of the user system 10. Specifically, as

shown in Fig. 7B, the threshold table  $T_3$  consists of items for No., resource, parameter and threshold. The parameters and the thresholds used in the evaluation of the performance of the CPU and the disk are stored in the correlation form.

5 That is, concerning the CPU, threshold values of CPU utility rate and execution queue for the CPU are set in "a" and "b". Similarly, concerning the disk, threshold values of disk utility rate, demand queue for the disk and disk response time are set in "x", "y" and "z". These threshold values (a, b, x, y, z) are determined on the basis of the maintenance know-how  
10 of the maintenance firm.

Returning to Fig. 4, the CPU list table  $T_4$  is a table showing a list of the plurality of CPUs applicable as system resources of the user system 10. That is, as shown in Fig. 7C,  
15 the CPU list table  $T_4$  is composed of No., CPU model name and CPU performance (clock frequency). The disk list table  $T_5$  is a table showing a list of the plurality of disks applicable as system resources of the user system 10 and is composed of No., disk model name and disk performance as shown in Fig. 7D.

20 Returning to Fig. 4, the table initial setting unit 23 is responsible for initial setting of the system configuration table  $T_1$  and application definition table  $T_2$ . The system information acquisition unit 24 acquires the system performance information  $J_1$  (see Fig. 5) from the memory unit 22 at the time  
25 of diagnosis and transfers it to the analysis unit 25. The



analysis unit 25 analyzes the system performance information  $J_1$  by referring to the system configuration table  $T_1$ , threshold table  $T_2$ , CPU list table  $T_3$ , and disk list table  $T_4$ , and transfers the result of analysis to the order processing unit 26. This analysis result represents the necessity or not of upgrading of system resources. The detail of method of analysis in the analysis unit 25 is described later.

The order processing unit 26 makes orders for system resources and compiles the system diagnosis report (see Fig. 13 to Fig. 15) on the basis of the result of analysis of the analysis unit 25. This system diagnosis report represents the result of diagnosis of the performance of system resources of the user system 10 and is presented to the user of the user system 10 after the diagnosis. The detail of this system diagnosis report is described later.

The user interface unit 27 works as an interface between different sections such as the input unit 28 and the display unit 29. The input unit 28 is the input device such as keyboard and mouse. The display unit 29 is the cathode-ray tube (CRT) or liquid crystal display (LCD) and displays information necessary for diagnosis or ordering. Reading unit 30 reads the information recorded in the recording medium 31 (in this case, system performance information  $J_1$ ) and stores it in the memory unit 22. The communication processing unit 32 communicates between the user system 10 and the factory/parts center system

40 through the network N according to the prescribed protocol.  
The printer 33 prints out the system diagnosis report (see Fig.  
13 to Fig. 15) as required.

The operation according to this embodiment is explained  
below while referring to the flowcharts shown in Fig. 8 to Fig.  
12. First, the person in charge at the maintenance firm  
initially sets the system configuration table  $T_1$  and application  
definition table  $T_2$  before starting diagnosis of the user system  
10. That is, the person in charge enters, concerning the user  
system 10, the information of machine ID, mounted CPU  
information, mounted disk information and application  
information shown in Fig. 6 using the input unit 28.

As a result, the information is stored in the table  
initial setting unit 23 through the user interface unit 27. The  
table initial setting unit 23 sets the information of machine  
ID, mounted CPU information, mounted disk information and  
application information in the system configuration table  $T_1$   
as shown in Fig. 6.

Next, the person in charge enters, concerning the user  
system 10, the application information and the upgrading flag  
shown in Fig. 7A using the input unit 28. Herein, the upgrading  
flag is entered on the basis of the result of necessity of  
upgrading confirmed beforehand by the user of the user system  
10. The information is stored in the table initial setting unit  
23 through the user interface unit 27 and is set in the

application definition table  $T_2$  (see Fig. 7A) through the table initial setting unit 23.

In operation, the user system 10 shown in Fig. 4 records the system performance information about system resources (CPU 11, disk 12) along the time sequence and stores it in a not shown memory unit. Herein, the system performance information includes, as mentioned above, the CPU utility rate (see Fig. 2A to Fig. 2C), execution queue for the CPU, disk utility rate (see Fig. 3A), demand queue for the disk and the disk response time (see Fig. 3B). Thus, in the user system 10, the system performance information is recorded as log in a not shown memory unit.

When diagnosing the system resources of the user system 10 on the basis of the system performance information, by the following first method or second method, the system performance information is acquired in the system diagnosis apparatus 20 from a not shown memory unit of the user system 10. That is, the first method is a method of acquiring the system performance information through the recording medium 31 and the second method is a method of acquiring the system performance information through the network N.

In the case of the first method, when a specific command is entered with the recording medium 31 being inserted into a not shown disk drive of the user system 10, the system performance information is readout from a not shown memory unit

and recorded in the recording medium 31. When this recording medium 31 is brought into the maintenance firm, the person in charge at the maintenance firm inserts the recording medium 31 into the reading unit 30 and enters a specific command using the input unit 28.

As a result, the reading unit 30 reads, for example, system performance information  $J_1$  shown in Fig. 5 from the recording medium 31 and stores it in the memory unit 22. Fig. 5 shows the information about one computer out of four computers that make the user system 10. Actually, the system performance information  $J_1$  includes the information all the about four computers.

In the case of the second method, when a specific command is entered using the input unit 28 by the person in charge at the maintenance firm, the communication processing unit 32 accesses the user system 10 through the network N and requests downloading of system performance information to the user system 10.

As a result, the user system 10 reads out the system performance information stored in a not shown memory unit and transmits it to the communication processing unit 32 of the system diagnosis apparatus 20 through the network N. The communication processing unit 32, after receiving the system performance information from the user system 10, stores the result of reception as system performance information  $J_1$  (see

Fig. 5) in the memory unit 22.

Under the condition that the system performance information  $J_1$  is stored in the memory unit 22, when a command instructing the diagnosis is entered using the input unit 28, the analysis unit 25 and system performance information acquisition unit 24 perform the process in step SA1 shown in Fig. 8 and execute system performance information acquisition process (see Fig. 9).

That is, at SB1 shown in Fig. 9, the analysis unit 25 accesses the memory unit 21 and acquires the mounted CPU information and mounted disk information from the system configuration table  $T_1$  (see Fig. 6). Consequently, at step SB2, the system performance information acquisition unit 24 accesses the memory unit 22 and acquires the system performance information  $J_1$  shown in Fig. 5 and transfers it to the analysis unit 25, thereby returning to the main routine shown in Fig. 8.

At step SA2 shown in Fig. 8, the analysis unit 25 executes CPU performance information analysis process (see Fig. 10). That is, at step SC1 shown in Fig. 10, the analysis unit 25 accesses the memory unit 22 and acquires the threshold "a" about the CPU utility rate and threshold "b" about the execution queue for the CPU from the threshold table  $T_2$  shown in Fig. 7B and advances to step SC2.

At step SC2, the analysis unit 25 judges whether the CPU

utility rate included in the system performance information  $J_1$  shown in Fig. 5 is above the threshold "a" or not (see Fig. 7B). In this case, the CPU utility rate is the value about the CPU (=SPII) mounted on the computer having the machine id of A shown in Fig. 6. The CPU utility rate of this CPU is the average of the CPU utility rate measured from 10:00:00 to 12:10:00 shown in Fig. 5 (=84%).

Herein, when the CPU utility rate (=84%) is smaller than the threshold "a", the analysis unit 25 judges "No" at step SC2 and the process returns to the main routine shown in Fig. 8. In this case, this CPU (=SPII, see Fig. 6) is performing as specified and it is judged that there is no need to upgrade. Thereafter, the analysis unit 25 similarly executes CPU performance information analysis process about the CPUs corresponding to B to D (machine ID) shown in Fig. 6.

That is, in the case of the CPU (=PTT) corresponding to B (machine ID) shown in Fig. 6, at step SC2 shown in Fig. 10, the analysis unit 25 judges whether the corresponding CPU utility rate included in the system performance information  $J_1$  is over the threshold "a" or not. In this case if the CPU utility rate is over the threshold "a", the analysis unit 25 judges "Yes" at step SC2 and advances to step SC3.

At step SC3, the analysis unit 25 judges whether the execution queue for the CPU relating to the CPU corresponding to B (machine ID) is longer than the threshold "b" or not (see

Fig. 7B). In this case, if the execution queue for the CPU is longer than the threshold "b", the analysis unit 25 judges "Yes" at step SC3 and advances to step SC4. That is, with this CPU there is a problem that the CPU utility rate is more than the threshold "a" and the execution queue for the CPU is longer than the threshold "b". This problem can be solved by adding (extending) the CPU having the same clock frequency as this CPU.

At step SC4, the analysis unit 25 determines the result of dividing the sum of the execution queue for the CPU concerning this CPU (=PTT) and number of CPUs mounted by the value "c" as the number of CPUs (for example, 2.5) and advances to step SC5. This number of CPU is the number of CPUs necessary for exhibiting the specified performance. At step SC5, the analysis unit 25 judges if the number of CPUs (2.5) determined at step SC4 is greater than the number of mountable CPUs (4) corresponding to B (machine ID) shown in Fig. 6.

In this case, the analysis unit 25 judges "No" at step SC4 and advances to step SC6. At step SC6, the analysis unit 25 determines the CPU model name and number of CPUs relating to the CPU after upgrading. More specifically, the analysis unit 25 determines the model name of the CPU after upgrading as the same PTT (see Fig. 6) as the model name of the CPU already mounted. Also, the analysis unit 25 determines the number of CPUs by rounding up the number of CPUs (2.5) determined at step SC4 to 3.

On the other hand, if judged "Yes" at step SC5, the analysis unit 25 advances to step SC10. In this case, since the number of CPUs after upgrading is over the number of mountable CPUs, all the CPUs cannot be mounted on this computer.

- 5 Therefore, at step SC10 to step SC12, by using the CPU having higher clock frequency than the clock frequency of the existing CPU, the process is executed to decrease the number of CPUs necessary for upgrading.

- That is, at step SC10, the analysis unit 25 determines  
10 the clock frequency multiplication factor by dividing the number of CPUs determined at step SC4 by the number of mountable CPUs (see Fig. 6) and advances to step SC11. This clock frequency multiplication factor is the ratio of the clock frequency necessary for exhibiting the specified performance  
15 by using the CPUs within the number of mountable CPUs and the clock frequency of this CPU already mounted.

- At step SC11, the analysis unit 25 searches the CPU having an optimum clock frequency from the CPU list table  $T_4$  shown in Fig. 7C and advances to step SC12. Specifically, the analysis  
20 unit 25 determines the product of the clock frequency of the existing CPU and the clock frequency multiplication factor determined at step SC10 as the clock frequency of the CPU after upgrading.

- Consequently, the analysis unit 25 searches the CPU of  
25 which clock frequency is higher than this clock frequency and



closest to this clock frequency from the CPU list table T<sub>4</sub> and advances to step SC12. For example, when the clock frequency of the CPU after upgrading is determined as 242 MHz, the CPU of model name ZZ1 assigned with No. 4 shown in Fig. 7C is searched as the CPU after upgrading.

At step SC12, the analysis unit 25 determines the CPU model name about the CPU after upgrading and the number of CPUs. Specifically, the analysis unit 25 determines the CPU model name of the CPU after upgrading as ZZ1 (see Fig. 7C). The analysis unit 25 also determines the number of mountable CPUs as the number of CPUs.

In the case of the CPU (=ZZ2) corresponding to C (machine ID) shown in Fig. 6, at step SC2, the analysis unit 25 judges if this CPU utility rate included in the system performance information J<sub>1</sub> is over the threshold "a" or not. In this case, supposing that the CPU utility rate is over the threshold "a", the analysis unit 25 judges "Yes" at step SC2 and advances to step SC3.

At step SC3, the analysis unit 25 judges if the execution queue for the CPU relating to the CPU corresponding to C (machine ID) is longer than the threshold "b" or not (see Fig. 7B). In this case, supposing the execution queue for the CPU is shorter than the threshold "b", the analysis unit 25 judges "No" at step SC3 and advances to step SC7. That is, with this CPU, the problem is that the CPU utility rate is greater than the

threshold "a". This problem can be solved by replacing this CPU with the CPU of higher clock frequency.

At step SC7, the analysis unit 25 determines the clock frequency multiplication factor by dividing the CPU utility rate of this CPU by the threshold "d" ( $<1$ ) and advances to step SC8. This clock frequency multiplication factor is the ratio of the clock frequency of the CPU necessary for exhibiting the specified performance and the clock frequency of this CPU already mounted.

At step SC8, the analysis unit 25 searches the CPU having an optimum clock frequency from the CPU list table T<sub>1</sub> shown in Fig. 7C and advances to step SC9. Specifically, the analysis unit 25 determines the product of the clock frequency of the existing CPU and the clock frequency multiplication factor determined at step SC7 as the clock frequency of the CPU after upgrading.

Consequently, the analysis unit 25 searches the CPU of which clock frequency is higher than this clock frequency and closest to this clock frequency from the CPU list table T<sub>1</sub> shown in Fig. 7C and advances to step SC9. For example, when the clock frequency of the CPU after upgrading is determined as 452 MHz, the CPU of CPU model name ZZ3 assigned with No. 6 shown in Fig. 7C is searched as the CPU after upgrading.

At step SC9, the analysis unit 25 determines the CPU model name about the CPU after upgrading and the number of CPUs.

Specifically, the analysis unit 25 determines the CPU model name of the CPU after upgrading as ZZ3 (see Fig. 7C). The analysis unit 25 also determines the number of mountable CPUs (2) corresponding to C (machine ID) shown in Fig. 6 as the number of CPUs.

In the case of the CPU (=AM2) corresponding to D (machine ID) shown in Fig. 6, at step SC2, the analysis unit 25 judges if this CPU utility rate included in the system performance information  $J_1$  is over the threshold "a" or not. In this case, supposing that the CPU utility rate is below the threshold "a", the analysis unit 25 judges "No" at step SC2 and returns to the main routine shown in Fig. 8.

Returning to Fig. 8, at step SA3, the analysis unit 25 executes disk performance information analysis process (see Fig. 11). That is, at step SD1 shown in Fig. 11, the analysis unit 25 accesses the memory unit 22 and acquires the threshold "x" about the disk utility rate, threshold "y" about the demand queue for the disk and threshold "z" about the disk response time from the threshold table  $T_1$  shown in Fig. 7B and advances to step SD2.

At step SD2, the analysis unit 25 judges if the disk utility rate included in the system performance information  $J_1$  shown in Fig. 5 is over the threshold "x" or not (see Fig. 7B). In this case, the disk utility rate is the value about the disk (SG2) mounted on the computer assigned with machine ID of A shown

in Fig. 6. The disk utility rate of this disk is the average (43%) of the disk utility rate measured from 10:00:00 to 12:10:00 shown in Fig. 5.

Herein, if the disk utility rate is over the threshold "x", the analysis unit 25 judges "Yes" at step SD2 and advances to step SD3. At step SD3, the analysis unit 25 judges if the demand queue for the disk relating to the disk corresponding to A (machine ID) (see Fig. 5) is shorter than the threshold "y" (see Fig. 7B) and if the disk response time (see Fig. 5) is longer than the threshold "z" (see Fig. 7B).

In this case, if the demand queue for the disk is longer than the threshold "y" and the disk response time is longer than the threshold "z", the analysis unit 25 judges "No" at step SD3 and advances to step SD4. That is, with the disk, the problems are that the disk utility is greater than threshold "x", the demand queue for disk is longer than the threshold "y" and the disk response time is longer than the threshold "z". All of these problems can be solved by adding (extending) the disk having the same rotating speed as this disk.

At step SD4, the analysis unit 25 first determines the product of the number of disks mounted (=1, see Fig. 6) about this disk (SG2), the disk utility rate (=43%, see Fig. 5) and the value "s" as the number of disks (for example, 1.6). This number of disks (=1.6) is the number of disks required for exhibiting the specified performance.

Next, the analysis unit 25 determines the number of disks by rounding up the number of disks (1.6) to 2 and determines the disk model name after upgrading as SG2 (see Fig. 6) same as the disk model name already mounted. Thereafter, the analysis unit 25 execute the disk performance information analysis process about the disks corresponding to B to D (machine ID) shown in Fig. 6.

That is, in the case of the disk (AL2) corresponding to B (machine ID) shown in Fig. 6, at step SD2, the analysis unit 25 judges if the disk utility rate about this disk is more than the threshold "x" or not (see Fig. 7B). In this case, since the utility rate is smaller than the threshold "x", the analysis unit 25 judges "No" at step SD2 and returns to the main routine shown in Fig. 8.

In the case of the disk (SGS) corresponding to C (machine ID) shown in Fig. 6, at step SD2, if the disk utility rate about this disk is more than the threshold "x", the analysis unit 25 judges "Yes" and advances to step SD3. At step SD3, the analysis unit 25 judges if the demand queue for the disk about the disk corresponding to C (machine ID) is shorter than the threshold "y" (see Fig. 7B) and if the disk response time is longer than the threshold "z" (see Fig. 7B).

In this case, if the demand queue for disk is longer than threshold "y" and the disk response time is longer than the threshold "z", the analysis unit 25 judges "No" at step SD3 and

advances to step SD4. That is, concerning this disk, the problems are that the disk utility rate is more than the threshold "x", that the demand queue for the disk is longer than the threshold "y" and that the disk response time is longer than the threshold "z". These problems can be solved by adding (extending) the disk having the same rotating speed as this disk.

At step SD4, the analysis unit 25 determines the product of the number of disks mounted (=5, see Fig. 6) about this disk (SGS), the disk utility rate and value "s" as the number of disks (for example, 6.5). This number of disks (6.5) is the number of disks necessary for exhibiting the specified performance.

Next, the analysis unit 25 determines the number of disks by rounding up the number of disks (6.5) to 7 and determines the disk model name after upgrading as SGS (see Fig. 6), same as the disk model name already mounted.

In the case of the disk (SG1) corresponding to D (machine ID) shown in Fig. 6, at step SD2, if the disk utility rate of this disk is more than the threshold "x", the analysis unit 25 judges "Yes" and advances to step SD3. At step SD3, the analysis unit 25 judges if the demand queue for the disk concerning the disk corresponding to D (machine ID) is shorter than the threshold "y" (see Fig. 7B) and if the disk response time is longer than the threshold "z" (See Fig. 7B).

In this case, if the demand queue for the disk about this

disk is shorter than the threshold "y" and the disk response time is longer than the threshold "z", the analysis unit 25 judges "Yes" at step SD3 and advances to step SD5. That is, concerning this disk, the problems are that the disk utility rate is greater than the threshold "x" and that the disk response time is longer than the threshold "z". These problems can be solved by replacing the existing disk with the disk having a higher rotating speed than the existing disk.

At step SD5, the analysis unit 25 determines the rotating speed multiplication factor by dividing the disk response time of this disk by value  $r$  ( $<1$ ) and advances to step SD6. This rotating speed multiplication factor is the ratio of the rotating speed of the disk necessary for exhibiting the specified performance and the rotating speed of this disk already mounted. The values  $c$ ,  $d$ ,  $s$  and  $r$  are decided by experience.

At step SD6, the analysis unit 25 searches the disk having an optimum rotating speed from the disk list table  $T_1$  shown in Fig. 7D and advances to step SD7. Specifically, the analysis unit 25 determines the product of the rotating speed of the existing disk and the rotating speed multiplication factor determined at step SD5 as the rotating speed of the disk after upgrading.

Consequently, the analysis unit 25 searches the disk of which rotating speed is higher than this rotating speed and

closest to this rotating speed from the disk list table T, shown in Fig. 7D and advances to step SD7. For example, when the rotating speed of the disk after upgrading is determined as 7100 rpm, the disk of model name AL2 assigned with No. 3 shown in Fig. 7D is searched as the disk after upgrading.

At step SD7, the analysis unit 25 determines the disk model name about the disk after upgrading and the number of disks. Specifically, the analysis unit 25 determines the disk model name of the disk after upgrading as AL2 (see Fig. 7D). The analysis unit 25 also determines the number of disks as the number of disks (=2) shown in Fig. 6 and returns to the main routine shown in Fig. 8.

Returning to Fig. 8, at step SA4, the analysis unit 25 judges whether or not to recommend upgrading of the CPU depending on whether or not the CPU model name and number of CPUs are determined at step SC6, step SC9 or step SC12 shown in Fig. 10. Similarly, the analysis unit 25 judges whether or not to recommend upgrading of the disk depending on whether or not the disk model name and number of disks are determined at step SD4 or SD7 shown in Fig. 11.

In this case, since the CPU model name and number of CPUs and the disk model name and number of disks are determined, the analysis unit 25 judges "Yes" at step SA4. Incidentally, if judged "No" at step SA4, the analysis unit 25 terminates the series of processing assuming there is no system resource (CPU,



disk) recommended to be upgraded.

At the next step SA5, the order processing unit 26 executes order processing (see Fig. 12). That is, at step SE1 shown in Fig. 12, the order processing unit 26 accesses the  
5 memory unit 21 and sets the CPU upgrade recommended information (disk upgrade recommended information) in the system configuration table  $T_1$  shown in Fig. 6.

In this case, the order processing unit 26 sets PTT, ZZ3 and PTT as the CPU model names of the CPU upgrade recommended  
10 information, relating to B, C and D (machine ID) in the system configuration table  $T_1$ . Similarly, the order processing unit 26 sets 3, 2 and 1 as the number of CPUs in the CPU upgrade recommended information in the system configuration table  $T_1$ , relating to B, C and D (machine ID) in the system configuration  
15 table  $T_1$ .

Moreover, the order processing unit 26 sets SG2, SGS and AL2 as the disk model names of the disk upgrade recommended information in the system configuration table  $T_1$ , relating to A, C and D (machine ID) in the system configuration table  $T_1$ .  
20 Similarly, the order processing unit 26 sets 2, 7 and 2 as the number of disks in the disk upgrade recommended information in the system configuration table  $T_1$ , relating to A, C and D (machine ID) in the system configuration table  $T_1$  and then advances to step SE2.

25 At step SE2, the order processing unit 26 accesses the

memory unit 21 and searches the upgrading flag relating to the same application information as the application information shown in Fig. 6, from the application definition table  $T_2$  shown in Fig. 7A. In this case, the order processing unit 26  
5 recognizes the application information "mail server" in the record of A (machine ID) shown in Fig. 6. Next, the order processing unit 26 searches the upgrading flag (=1) corresponding to the application information "mail server" in the application definition table  $T_2$  shown in Fig. 7A same as  
10 the aforesaid application information "mail server."

Similarly, thereafter, the order processing unit 26 searches the upgrading flag (=1, 1 and 0) about the application information "printer server," "job server," and "personal terminal" shown in Fig. 6, from the application definition table  
15  $T_2$  shown in Fig. 7A and advances to step SE3. At step SE3, the order processing unit 26 judges if necessary to upgrade or not, about the system resources of the computer (CPU, disk), on the basis of the retrieval result at step SE2.

In this case, concerning the mail server, printer server  
20 and job server (see application information) shown in Fig. 6, since the upgrading flag (see Fig. 7A) is 1 in all of them, the order processing unit 26 judges "Yes" at step SE3 and advances to step SE4. At step SE4, the order processing unit 26 sets the CPU order information and disk order information in the  
25 system configuration table  $T_1$  on the basis of the CPU upgrade

recommended information, disk upgrade recommended information and upgrading flag shown in Fig. 6 and advances to step SE6.

In this case, first, since the upgrading flag is 1 (see Fig. 7A) as for the mail server (application information) shown in Fig. 6, the order processing unit 26 sets SG2 (disk model name) of the disk upgrade recommended information in the disk model name of the disk order information. Also, the order processing unit 26, concerning the mail server shown in Fig. 6, sets the result (=1) of subtracting the number of disks mounted (=1) in the mounted disk information from the number of disks (=2) in the disk upgrade recommended information in the number of disks ordered in the disk order information.

Similarly, since the upgrading flag is 1 (see Fig. 7A) as for the printer server (application information) shown in Fig. 6, the order processing unit 26 sets PTT (CPU model name) of the CPU upgrade recommended information in the CPU model name of the CPU order information. Also, the order processing unit 26, concerning the printer server shown in Fig. 6, sets the result (=1) of subtracting the number of CPUs mounted (=2) in the mounted CPU information from the number of CPUs (=3) in the CPU upgrade recommended information in the CPU order quantity in the CPU order information.

Also, since the upgrading flag is 1 (see Fig. 7A) as for the job server (application information) shown in Fig. 6, the order processing unit 26 sets ZZ3 (CPU model name) of the CPU

upgrade recommended information in the CPU model name of the  
CPU order information. Also, the order processing unit 26,  
concerning the job server shown in Fig. 6, sets the number of  
CPUs (=2) in the CPU upgrade recommended information in the  
5 number of CPUs ordered in the CPU order information.

Moreover, concerning the job server, the order processing  
unit 26 sets SGS (disk model name) of the disk upgrade  
recommended information in the disk model name of the disk order  
information. Further, the order processing unit 26,  
10 concerning the job server shown in Fig. 6, sets the result (=2)  
of subtracting the number of disks mounted (=5) in the mounted  
disk information from the number of disks (=7) in the disk  
upgrade recommended information in the number of disks ordered  
in the disk order information.

15 Concerning the individual information (application  
information) shown in Fig. 6, since the upgrading flag is 0 (see  
Fig. 7A), the order processing unit 26 does not set the CPU order  
information and disk order information although upgrading of  
CPU and disk is recommended. In this case, that is, the CPU  
20 and disk of the personal terminal are not updated by the  
judgement of the user.

At step SE5, the order processing unit 26 compiles the  
system diagnosis report in the computer unit on the basis of  
the performance diagnosis result of the system resources in the  
25 user system 10 and transmits the information of this system

diagnosis report to the user system 10 (user) through the communication processing unit 32 and network N and advances to step SE6. This system diagnosis information includes the date of diagnosis, system resources of computers, results of system diagnosis, problems, countermeasures and other information.

Fig. 13 to Fig. 15 are diagrams showing examples of system diagnosis report about the job server (application information) shown in Fig. 6 that makes the user system 10. In Fig. 13, "1. System diagnosis subject" consists of Customer name, Date of diagnosis, Hardware and Software. In the item of Hardware, ZZ2 is described as the CPU (CPU model name in Fig. 6) and 5 is given as the number of disks (number of disks mounted in Fig. 6).

In Fig. 14, "2. System diagnosis result" shows the system diagnosis result in each time zone (morning, afternoon, evening, night) about each resource (CPU, memory, disk and network), by weather marks, sunny, cloudy and rain. The sunny mark means there is no problem in performance and the cloudy mark indicates it is necessary to diagnose continuously. The rain mark means there is a problem in performance. In the example shown in Fig. 14, in the CPU and disk, rain marks are indicated in the time zone of 12:00 to 18:00 and there are problems in performance.

In Fig. 15, "3. Problem and tuning advice" describes problems and tuning advice (countermeasure) of each resource (CPU, memory, disk and network). Herein, the smile mark means there is no problem.

In the example shown in Fig. 15, concerning the CPU, the high CPU utility rate is indicated as a problem and upgrading of clock speed (from 400 MHz to 500 MHz) of the CPU is recommended as the tuning advice. Concerning the disk, the high load of the disk due to paging is indicated as a problem and it is recommended to add two disks.

Returning to Fig. 12, at step SE6, the order processing unit 26 judges if the user has approved the upgrading or not. When the information of the system diagnosis report is received in the user system 10, the user system 10 displays the system diagnosis report in the display unit (not shown), or prints it out. Accordingly, the user of the user system 10 judges whether or not to upgrade as recommended by the maintenance firm according to the content of the system diagnosis report.

The user manipulates the user system 10 and transmits the reply about upgrading to the system diagnosis apparatus 20 through the network N. When this reply information is received in the communication processing unit 32, the order processing unit 26 judges whether the upgrading is approved by the user or not and, if not approved, judges "No" and terminates the series of processing.

When approved by the user, the order processing unit 26 judges "Yes" at step SE6 and advances to step SE7. At step SE7, the order processing unit 26 assigns the records out of the records in the system configuration table  $T_1$  (in this case,

records A, B and C = machine ID) shown in Fig. 6 with order number, for example, JJ1999080512 (see Fig. 16). The order processing unit 26 notices the order number by e-mail or the like to the computer terminals (not shown) of the sales person and maintenance person in charge of the user of the user system 10 and advances to step SE8.

At step SE8, the order processing unit 26 displays an order confirm screen 100 shown in Fig. 16 on the display unit 29 and advances to step SE9. This order confirm screen 100 is a screen for ordering the system resources approved by the user to the factor/parts center system 40. In this illustrated example, the order confirm screen 100 includes the order number given at step SE7 (JJ1999080512), CPU model name (PTT, ZZ3), quantity (1, 2), disk model name (SG2, SGS) and quantity (1, 2).

Herein, the CPU model name and quantity correspond to the CPU model name and number of CPUs ordered in the CPU order information shown in Fig. 6. Similarly, the disk model name and quantity correspond to the disk model name and number of disks ordered in the disk order information shown in Fig. 6. The order confirm screen 100 also shows a soft button 101 for instructing the order and a soft button 102 for canceling the order.

At step SE9, the order processing unit 26 judges if the order instruction of the system resources (CPU, disk) is issued

by the person in charge at the maintenance firm. Specifically, the order processing unit 26 judges if the soft button 101 of the order confirm screen 100 shown in Fig. 16 is pressed or not.

When the soft button 101 is pressed by the person in charge who has confirmed the order confirm screen 100 by using the input unit 28, the order processing unit 26 judges "Yes" at step SE9 and advances to step SE10. When the soft button 102 of the order confirm screen 100 is pressed, the order processing unit 26 judges "No" at step SE9 and terminates the series of processing without ordering system resources.

In this case, at step SE10, the order processing unit 26 transmits the order information about the CPU and disk composed of order number, CPU model name, quantity, disk model name and quantity in the order confirm screen 100 shown in Fig. 16 to the factory/parts center system 40 through the communication processing unit 32 and network N.

When the order information is received in the factory/parts center system 40, the order information is displayed in the display unit (not shown) of the factory/parts center system 40. As a result, the CPU and disk for upgrading are delivered to the user from the factory/parts center. The person in charge at the maintenance firm installs the delivered system resources (CPU, disk) in the mail server, printer server and job server in the user system 10. Thus, the system resources are upgraded.



As explained herein, according to this embodiment, the system resources are diagnosed on the basis of the CPU utility rate about the system resources (CPU, disk), execution queue for the CPU, disk utility rate, demand queue for the disk, response time and the corresponding threshold "a", threshold "b", threshold "x", threshold "y" and threshold "z" (see Fig. 7B) and results of comparison between them and therefore measures against lowering of performance of system resources or shortage of system resources can be carried out accurately and quickly.

Further, since system resources are ordered from the factory/parts center system 40 through the network N by using the order processing unit 26 on the basis of the results of analysis by the analysis unit 25, system resources can be ordered quickly and accurately.

Further, the information of the system diagnosis report (see Fig. 13 to Fig. 15) about the user system 10 is noticed to the user through the network N, the time from request of diagnosis till reporting of the result of diagnosis to the user is shortened, so that the quality of customer service can be enhanced.

Further, on the basis of the upgrading flag shown in Fig. 7A, of the system resources recommended to be upgraded, only the system resources required to be upgraded can be ordered as the system resources for upgrading, so that the user's judgement

whether or not to upgrade is quickly applied in ordering.

The embodiment of the present invention has been described in detail while referring to the accompanying drawings, but specific examples of constitution are not limited to this embodiment alone and changes and modifications within the scope of the present invention are also included in the present invention. For example, in this embodiment, the system diagnosis program for realizing the function of the system diagnosis apparatus 20 may be recorded in a computer-recordable recording medium 300 shown in Fig. 17 and the system diagnosis program recorded in this recording medium 300 may be read into a computer 200 shown in the diagram and executed, so that the resources (CPU, disk, etc.) can be diagnoses.

The computer 200 shown in Fig. 17 comprises CPU 201 for executing this system diagnosis program, input device 202 such as keyboard and mouse, read-only memory (ROM) 203 for storing data, random access memory (RAM) 204 for storing operation parameters, reading unit 205 for reading the system diagnosis program from the recording medium 300, output device 206 such as display and printer and buses BU for connecting the device parts.

The CPU 201 reads in the system diagnosis program recorded in the recording medium 300 through the reading unit 205 and executes the system diagnosis program and thereby diagnoses the system resources. The recording medium 300 includes not only

portable recording media such as optical disk, floppy disk and hard disk, but also includes a transfer medium for recording and hold data temporarily such as network.

In the embodiment, the information of the system  
5 diagnosis report is transmitted to the user system 10 through the network N, but not limited to this, the system diagnosis report may be printed out by the printer 33 and it may be sent to the user by facsimile or mail, or directly brought to the user.

10 In the embodiment, the information about whether or not to upgrade is transmitted to the system diagnosis apparatus 20 from the user system 10 through the network N, but not limited to this, the reply of upgrading or not may be reported to the maintenance firm by telephone, facsimile or the like. In this  
15 case, the person in charge receiving the reply from the user enters the information about upgrading by using the input unit 28. As a result, the order processing unit 26 executes the process after step SE6 shown in Fig. 12.

Further, in the embodiment, it is designed to diagnose  
20 by using the average values of the CPU utility rate, execution queue for the CPU, disk utility rate, demand queue for the disk and disk response time shown in Fig. 5, but it may be also diagnosed by using, for example, the maximum values of the CPU utility rate, execution queue for the CPU, disk utility rate,  
25 demand queue for the disk and disk response time in the system

performance information  $J_1$ .

In addition, in the embodiment, the system diagnosis report (see Fig. 13 to Fig. 15) is presented to the user and system resources are ordered after obtaining the final approval  
5 by the user about upgrading of system resources, but system resources may be ordered only on the basis of the upgrading flag of the application definition table  $T_2$  (see Fig. 7A). That is, as for the system resources of which upgrading flag is 1 in the application definition table  $T_2$ , they are ordered automatically  
10 without obtaining the final approval of the user. In this case, the order processing is done quickly.

According to one aspect of this invention, the system resources are diagnosed on the basis of the results of comparison between the utility rate and its threshold and  
15 between the queue and its threshold. Therefore, measures against performance drop of system resources or shortage of system resources can be executed accurately and quickly.

Further, the system resources for upgrading are ordered by the ordering unit on the basis of the result of determination  
20 by the system resource determining unit. Therefore, the system resources can be ordered quickly and accurately.

Further, the ordering unit directly transmits the ordering information about the system resources for updating to the device of the supplier's side through the network.  
25 Therefore, the system resources can be ordered more quickly and

accurately.

Further, the result of diagnosis by the diagnosis unit is noticed to the user through the network. Therefore, the time from request of diagnosis till report of diagnosis result to the user is shortened and the quality of customer service is enhanced.

Further, out of the system resources determined by the system resource determining unit only the system resources required to be updated are ordered as the system resources for upgrading on the basis of the flag. Therefore, the user's judgement whether upgrading is required or not can be promptly fed back to the ordering.

Further, the system resources are diagnosed on the basis of the results of comparison between the utility rate and its threshold, comparison between the queue and its and further comparison between the response time and its threshold. Therefore, the system resources can be diagnosed more accurately.

Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth.

WHAT IS CLAIMED IS:

1. A system diagnosis apparatus comprising:

an acquisition unit which acquires information on a utility rate of the system resources and a queue for the system resources that make the system of a computer;

a memory unit which stores thresholds of the utility rate and the queue, which thresholds represent the limits at which said system resource exhibit a desired performance; and

a diagnosis unit which diagnoses that the performance of the system resource has lowered when the utility rate is higher than the threshold of the utility rate and the queue is shorter than the threshold of the queue, or diagnoses that the number of the system resources is insufficient when the utility rate is higher than the threshold of the utility rate and the queue is longer than the threshold of the queue.

2. The system diagnosis apparatus according to claim 1, further comprising

a system resource determining unit which determines a system resource capable of giving the desired performance when it is diagnosed by said diagnosis unit that the performance of the system resource has lowered, or determines a number of the system resources capable of giving the desired performance when it is diagnosed by said system diagnosis unit that the number of the system resources is insufficient; and

an ordering unit which orders the system resource determined by said system resource determining unit as the system resource for upgrading.

5 3. The system diagnosis apparatus according to claim 2, wherein said ordering unit transmits, utilizing a network, the ordering information on the system resources to a device installed at the supplier of the system resources.

10 4. The system diagnosis apparatus according to claim 1, further comprising a notifying unit which notifies, utilizing a network, the result of diagnosis by said diagnosis unit to the user of the system.

15 5. A system diagnosis apparatus according to claim 2, wherein

said memory unit stores in correlation to each of said system resource a flag indicating necessity or not of upgrade, which necessity is judged by the user, and

20 said ordering unit orders only the system resources that have a flag that indicate necessity of upgrade out of the system resources determined by said system resource determining unit as the system resources for upgrading.

25 6. The system diagnosis apparatus according to claim 1,

wherein

said acquisition unit acquires information on a response time of the system resources in addition to the utility rate and the queue,

5       said memory unit stores a threshold of the response, which threshold represents the limits at which said system resource exhibits a desired performance, in addition to the thresholds of the utility rate and the queue, and

10       said diagnosis unit makes the diagnosis on the basis of the result of comparison between the acquired response time and the threshold of response time.

7.     A system diagnosis method comprising the steps of:

15       acquiring an information on a utility rate of the system resources and a queue for the system resources that make the system of a computer;

storing thresholds of the utility rate and the queue, which thresholds represent the limits at which said system resource exhibit a desired performance; and

20       diagnosing that the performance of the system resource has lowered when the utility rate is higher than the threshold of the utility rate and the queue is shorter than the threshold of the queue, or diagnosing that the number of the system resources is insufficient when the utility rate is higher than  
25       the threshold of the utility rate and the queue is longer than



the threshold of the queue.

8. A computer-readable recording medium recording a system diagnosis program for causing the computer to execute the steps

5 of:

acquiring an information on a utility rate of the system resources and a queue for the system resources that make the system of a computer;

10 storing thresholds of the utility rate and the queue, which thresholds represent the limits at which said system resource exhibit a desired performance; and

15 diagnosing that the performance of the system resource has lowered when the utility rate is higher than the threshold of the utility rate and the queue is shorter than the threshold of the queue, or diagnosing that the number of the system resources is insufficient when the utility rate is higher than the threshold of the utility rate and the queue is longer than the threshold of the queue.

ABSTRACT OF THE DISCLOSURE

A system diagnosis apparatus comprises a communication processing device which acquires a utility rate of the system resources of a user system and a queue for the system resources,  
5 a memory device stores thresholds of the utility rate and the queue. An analysis device is provided which decides that the performance of the system resource has lowered when the utility rate is more than its threshold and the queue is shorter than its threshold, or decides that the number of system resources  
10 is insufficient when the utility rate is more than its threshold and the queue is longer than its threshold.

FIG.1

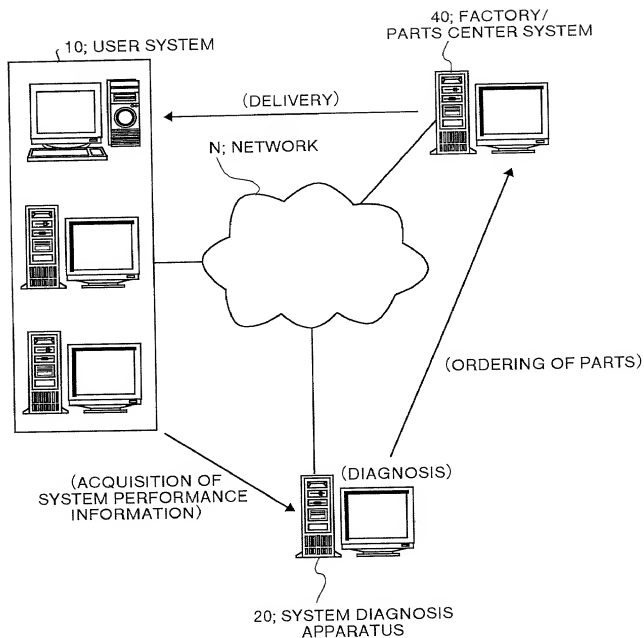


FIG.2A

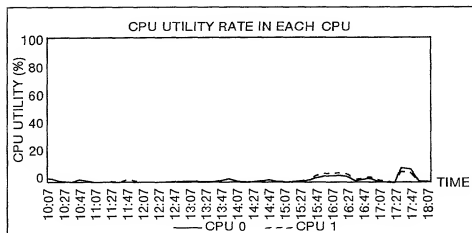


FIG.2B

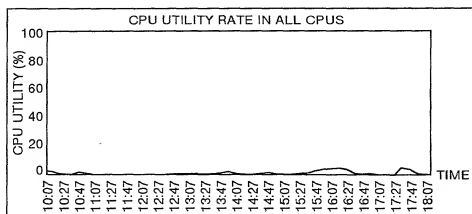


FIG.2C

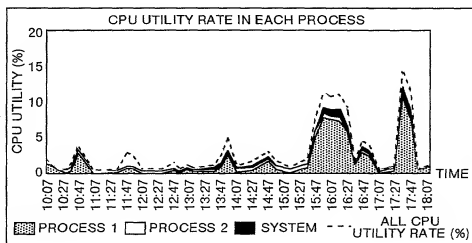


FIG.3A

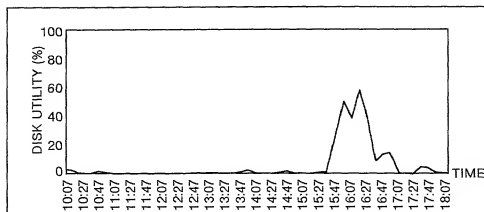


FIG.3B

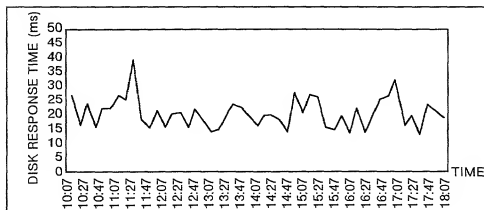


FIG. 4

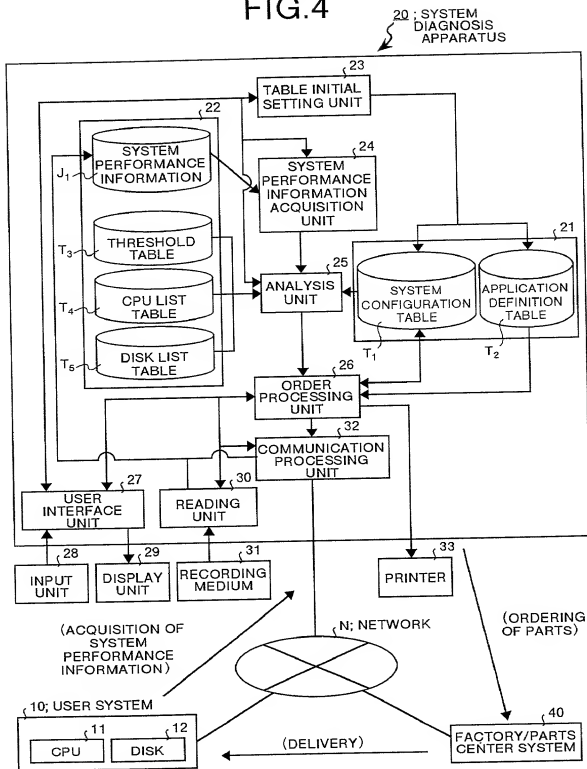


FIG.5

J<sub>1</sub>:SYSTEM PERFORMANCE INFORMATION

	CPU UTILITY RATE (%)	EXECUTION QUEUE FOR CPU (PCS)	DISK UTILITY RATE (%)	DEMAND QUEUE FOR DISK	DISK RESPONSE TIME (ms)
10:00:00	30	0	10	3	30
10:10:00	35	0	80	5	67
10:20:00	30	0	77	8	70
10:30:00	84	3	30	1	34
10:40:00	90	4	30	0	20
10:50:00	97	6	22	1	19
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
12:00:00	93	7	13	0	22
12:10:00	70	4	8	0	33
AVERAGE	84	3	43	1	32

CPU PERFORMANCE INFORMATION      DISK PERFORMANCE INFORMATION

FIG.6

T<sub>1</sub> SYSTEM CONFIGURATION TABLE

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MACHINE ID	MOUNTED CPU INFORMATION				MOUNTED DISK INFORMATION				APPLICATION INFORMATION	CPU UPGRADE RECOMMEND INFORMATION		DISK UPGRADE RECOMMEND INFORMATION		CPU ORDER INFORMATION		DISK ORDER INFORMATION	
	NO. OF MOUNTABLE CPUS	CPU MODEL NAME	CPU PERFORMANCE (CLOCK FREQUENCY, MHZ)	NO. OF CPUS	DISK MODEL NAME	DISK PERFORMANCE (ROTATING SPEED,RPM)	NO. OF DISKS MOUNTED			CPU MODEL NAME	NO. OF CPUS	DISK MODEL NAME	NO. OF DISKS	CPU MODEL NAME	NO. OF CPUS ORDERED	DISK MODEL NAME	NO. OF DISKS ORDERED
A	2	SPII	233	1	SG2	5500	1	MAIL SERVER				SG2	2			SG2	1
B	4	PTT	200	2	AL2	7200	3	PRINTER SERVER	PTT	3				PTT	1		
C	2	Z22	400	2	SGS	10000	5	JOB SERVER	Z23	2	SGS	7		Z23	2	SGS	2
D	1	AM2	133	1	SG1	4500	2	PERSONAL TERMINAL	PTT	1	AL2	1					



T<sub>2</sub>: APPLICATION DEFENITION TABLE

APPLICATION INFORMATION	UPGRADING FLAG
MAIL SERVER	1
PRINTER SERVER	1
FTP SERVER	0
JOB SERVER	1
PERSONAL TERMINAL	0

FIG.7A

T<sub>3</sub>: THRESHOLD TABLE

No.	RESOURCE	PARAMETER	THRESHOLD
1	CPU	CPU UTILITY RATE	a (%)
2	CPU	LENGTH OF EXECUTION QUEUE FOR CPU	b (PCS)
3	DISK	DISK UTILITY RATE	x (%)
4	DISK	LENGTH OF DEMAND QUEUE FOR DISK	y (PCS)
5	DISK	DISK RESPONSE TIME	z (ms)

FIG.7B

T<sub>4</sub>: CPU LIST TABLE



No.	CPU MODEL NAME	CPU PERFORMANCE (CLOCK FREQUENCY, MHz)
1	AM2	133
2	PTT	200
3	SP11	233
4	ZZ1	300
5	ZZ2	400
6	ZZ3	500

FIG.7C

T<sub>5</sub>: DISK LIST TABLE



No.	DISK MODEL NAME	DISK PERFORMANCE (ROTATING SPEED, RPM)
1	SG1	4500
2	SG2	5500
3	AL2	7200
4	SGS	10000

FIG.7D

FIG.8

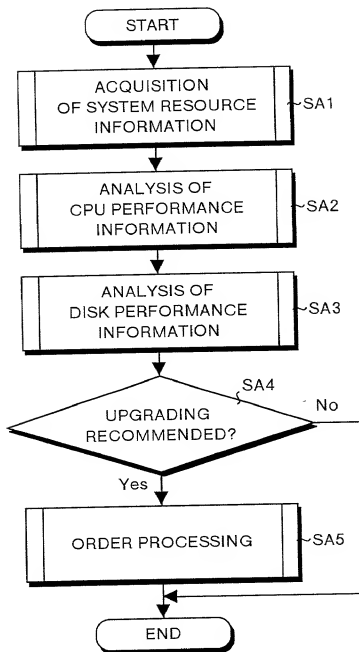


FIG.9

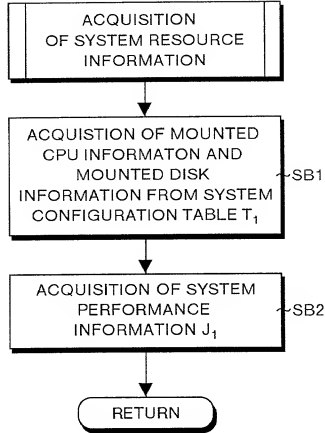


FIG.10

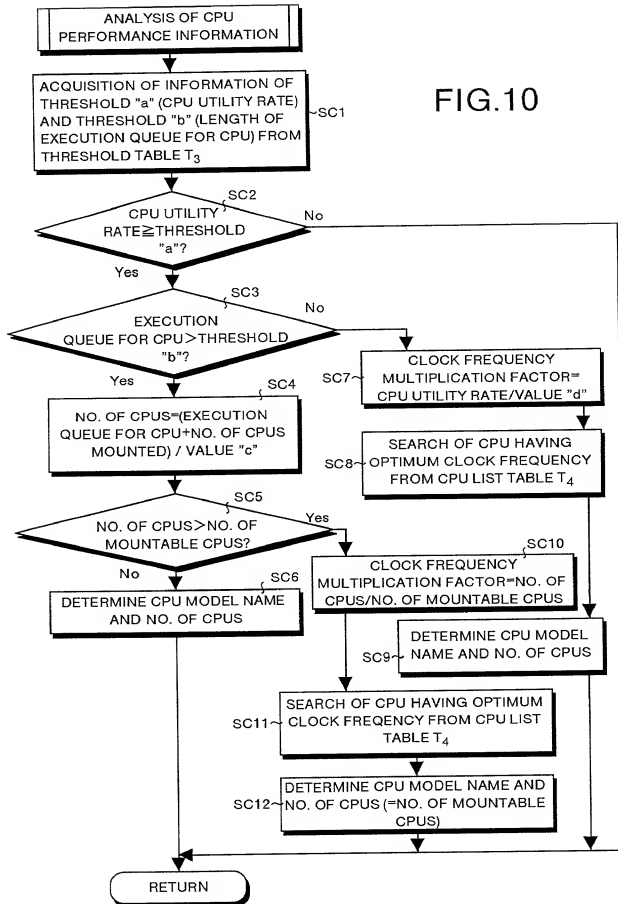


FIG.11

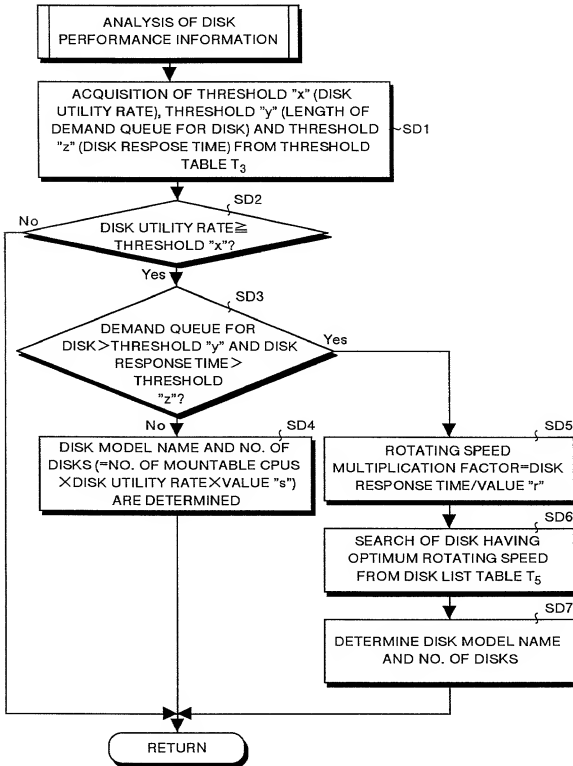
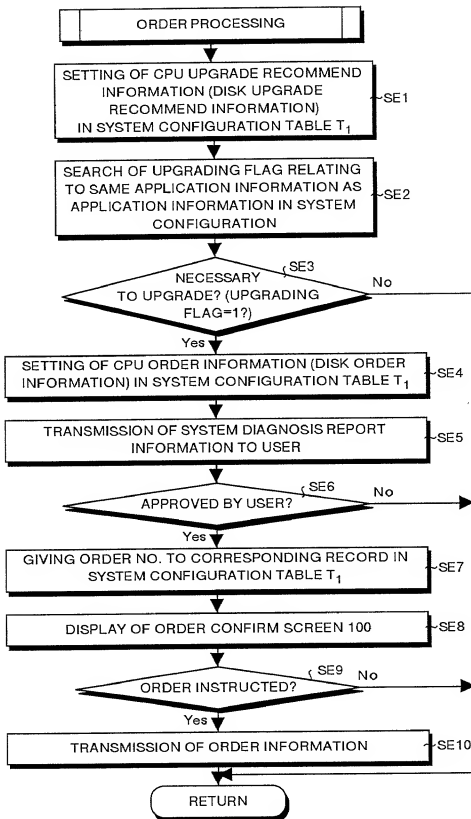


FIG.12



## FIG.13

TO ABC COMPANY

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JUNE 25, 1999  
F COMPANYSYSTEM DIAGNOSIS REPORT

## 1. SYSTEM DIAGNOSIS SUBJECT

CUSTOMER NAME:

ABC COMPANY

DATA OF DIAGNOSIS:

JUNE 16, 1999; THURSDAY, 9:57 TO 18:07

## HARDWARE

COMPUTER NAME	GPSVR
MODEL NAME	DEF OF F COMPANY
CPU	ZZ2 400MHz×2
MEMORY	64MB
DISK	5 UNITS
NETWORK	100BASE-TX

## SOFTWARE









OS	GHI
----	-----



FIG.14

PAGE (2/3)

## 2. SYSTEM DIAGNOSIS RESULT

RESOURCE	JUNE 16				
	MORNING 08:00~12:00	AFTERNOON 12:00~18:00	EVENING 18:00~24:00	NIGHT 00:00~08:00	MORNING 08:00~12:00
CPU			—	—	—
MEMORY			—	—	—
DISK			—	—	—
NETWORK			—	—	—

## 【LEGEND】








MARK	MEANING
	NO PROBLEM IN PERFORMANCE. CONTINUE TO USE AS USUAL.
	NEEDS CONTINUED DIAGNOSIS. CARE IS NEEDED WHEN EXPANDING BUSINESS.
	PROBLEM FOUND IN PERFORMANCE. CONFORM TO TUNING ADVICE.
—	NO DATA SAMPLED THIS TIME.


FIG.15

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## 3. PROBLEM AND TUNING ADVICE

RESOURCE	PROBLEM	TUNING ADVICE
CPU	INCREASED CPU UTILITY RATE.	RECOMMEND TO INCREASE CLOCK SPEED OF CPU. CHANGE FROM PRESENT 400MHzX2 TO 500MHzX2.
MEMORY		
DISK	DISK LOAD INCREASED DUE TO PAGING.	DISK LOAD CAN BE REDUCED BY ADDING TWO DISKS.
NETWORK		

## 【LEGEND】

MARK	MEANING
	NO PROBLEM.
—	NOT DIAGNOSED THIS TIME.

FOR INQUIRY ABOUT REPORT,CONTACT:  
 F COMPANY  
 PERSON IN CHARGE :  
 YOSHIMURA OR NOMURA  
 TELEPHONE : XXX-XXX-XXXX

FIG.16

100; ORDER CONFIRM SCREEN

ORDER NO.JJ1999080512

	CPU MODEL NAME	QUANTITY
<input checked="" type="checkbox"/>	PTT	1
<input type="checkbox"/>	ZZ3	2

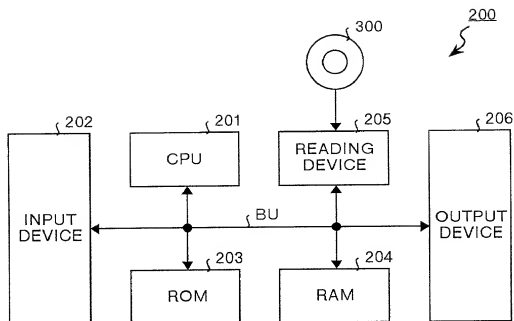
  

	DISK MODEL NAME	QUANTITY
<input checked="" type="checkbox"/>	SG2	1
<input type="checkbox"/>	SGS	2

CONFIRM THE ORDER ?

101 102

FIG.17



Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## Declaration and Power of Attorney For Patent Application

### 特許出願宣言書及び委任状

### Japanese Language Declaration

### 日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

SYSTEM DIAGNOSIS APPARATUS, SYSTEM  
 DIAGNOSIS METHOD AND COMPUTER-READABLE  
 RECORDING MEDIUM RECORDING SYSTEM  
 DIAGNOSIS PROGRAM

上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

☐ 月 日に出発され、米国出願番号または特許協定条約  
 国際出願番号を \_\_\_\_\_ とし、  
 （該当する場合） \_\_\_\_\_ に訂正されました。

☐ was filed on \_\_\_\_\_  
 as United States Application Number or  
 PCT International Application Number  
 \_\_\_\_\_ and was amended on  
 \_\_\_\_\_ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

# Japanese Language Declaration (日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している。本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

## Prior Foreign Application(s)

外国での先行出願  
11-246520

(Number)  
(番号)

Japan

(Country)  
(国名)

31/August/1999

(Day/Month/Year Filed)  
(出願年月日)

(Number)  
(番号)

(Country)  
(国名)

(Day/Month/Year Filed)  
(出願年月日)

私は、第35編米国法典119条(e)項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条(c)項に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じているところに基づき表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の表明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed  
優先権主張なし

☐

☐

I hereby claim the benefit under Title 36, United States Code, Section 119(e) of any United States provisional application(s) listed below.

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## Japanese Language Declaration (日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。(弁理士、または代理人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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Lawrence J. Crain	31,497
Steven P. Fallon	35,132



<u>Attorney</u>	<u>Reg. No.</u>
James K. Folker	37,538
Jonathan D. Feuchtwang	41,017
B. Joe Kim	41,895
Joel H. Bootzin	42,343

直接電話連絡先： (名前及び電話番号)

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Chicago, IL 60606 (312) 993-0080

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国籍		Citizenship Japanese	
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第二共同発明者		Full name of second joint inventor, if any Makoto IKARASHI	
第二共同発明者	日付	Second inventor's signature 	Date Jan. 25, 2000
住所		Residence Kanagawa, Japan	
国籍		Citizenship Japanese	
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(第三以降の共同発明者についても同様に記載し、署名をすること)

(Supply similar information and signature for third and subsequent joint inventors.)

第三共同発明者		Full name of third joint inventor, if any Shoichi SATOH	
第三共同発明者	日付	Third inventor's signature <i>Shoichi Satoh</i>	Date Jan. 25, 2000
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第四共同発明者		Full name of fourth joint inventor, if any Toshiaki NOMURA	
第四共同発明者	日付	Fourth inventor's signature <i>Toshiaki Nomura</i>	Date Jan. 25, 2000
住 所		Residence Kanagawa, Japan	
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第五共同発明者		Full name of fifth joint inventor, if any	
第五共同発明者	日付	Fifth inventor's signature	Date
住 所		Residence	
国 籍		Citizenship	
私書箱		Post Office Address	
第六共同発明者		Full name of sixth joint inventor, if any	
第六共同発明者	日付	Sixth inventor's signature	Date
住 所		Residence	
国 籍		Citizenship	
私書箱		Post Office Address	

(第七以降の共同発明者についても同様に記載し、署名をすること)

(Supply similar information and signature for seventh and subsequent joint inventors.)